SUPPORTING INFORMATION

Introduction

Supporting information included in this supplement include: 1) details about the Arecibo radar images; 2) a movie of the NAC mosaics produced to determine the illumination conditions in Mercury's south polar region; and 3) information related to craters mapped at Mercury's south polar region.

S1. Arecibo Radar Images

The Arecibo radar data and supporting documentation are available in the web directory: www.naic.edu/~radarusr/Mercpole
In particular, the 2005 image is labeled "Image7a" and the 2012 image is labeled "Image8" in this web directory.

The error parameter *rms* represents one noise standard deviation of the image – this statistical uncertainty is the standard deviations of the weighted average of the same-sense and opposite-sense reflectivities. This value is not expected to change from pixel to pixel, except in those areas that are beyond the radar horizon on some observing dates. Thus, this error strictly applies only to those portions of the image that are visible (within the radar horizon) on all of the dates contributing to the multi-day summed image. For the two radar images of Mercury's south pole used in this study, pixels beyond the radar horizon were set to a value of zero. For Mercury's south pole:
The 2005 Arecibo radar image, published in Harmon et al. (2011), has an *rms* value of 0.0203.
The 2012 Arecibo radar image, published in this work, has an *rms* value of 0.0095.

S2. Craters Mapped at Mercury's South Polar Region

Craters at Mercury's south polar region that hosted regions of permanent shadow were mapped down to a diameter of 6 km. Each crater was classified as also hosting a radar-bright feature or not. Data Set S1 provides the diameter, location, and classification of the 388 permanently shadowed craters mapped. Figure S1 displays the locations of the mapped craters and their classifications, and Figure S2 plots the craters and their classifications based on their longitudes. Table S1 provides the percentages of craters that do and do not host radar-bright deposits, divided into hot-pole and cold-pole bins.

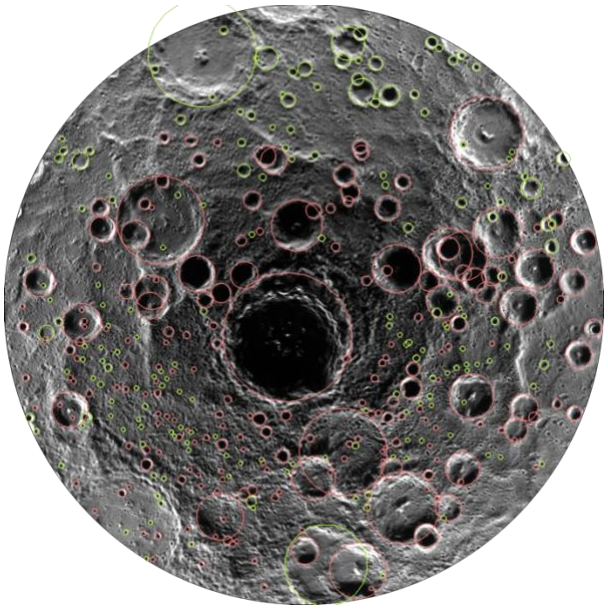

Figure S1. Craters with permanently shadowed regions mapped near Mercury's south pole. Craters were also classified into whether they hosted sizable radar-bright features (pink outline) or whether they did not (green outline). Orthographic projection, centered on 90°S, with 0° longitude at the top and extending to 80°S.

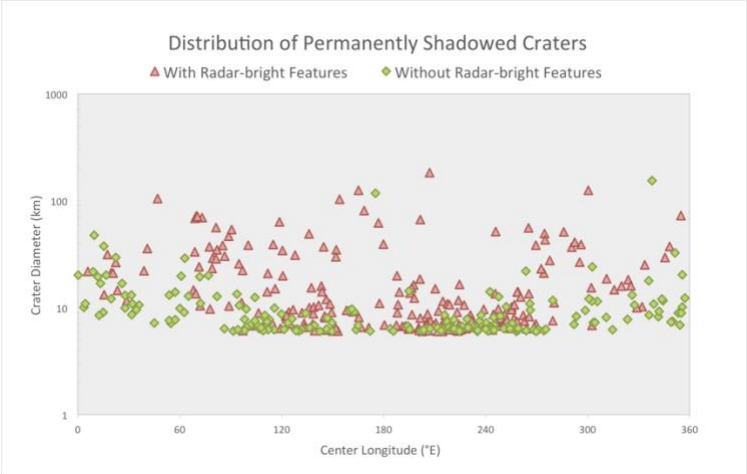

Figure S2. Craters with permanently shadowed regions within 10° latitude of Mercury's south pole are plotted as a function of their diameters and center longitudes. Permanently shadowed craters are divided into two classifications: those that host radar-bright deposits (pink triangles) and those that do not (green diamonds).

Diameter	All	Hot Pole (315°E–45°E)	Cold Pole (45°E–135°E)	Hot Pole (135°E–225°E)	Cold Pole (45°E–135°E)
All craters	53.6%	31.7%	50.0%	69.2%	52.7%
<10 km	42.9%	0.0%	30.2%	58.0%	44.0%
≥10 km	68.3%	41.7%	73.3%	94.4%	71.4%

Table S1. Percent of permanently shadowed craters that have radar-bright deposits from 80°S to 90°S.

Data Set S1. For the 388 craters mapped in Mercury's south polar region, this file provides the center latitude, center longitude, and diameter for each, along with whether each crater is classified as hosting a radar-bright deposit or not.

Movie S1. Movie showing the 51 NAC mosaics produced to determine the illumination conditions at Mercury's south pole. All mosaics are in a polar stereographic projection, with 0° longitude at the top and extending to 80°S.